Standards Requirements Package 5: Personal, Transit, and HAZMAT MAYDAYS

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1 Introduction to Standards Requirements Documentation

The Standards Requirements Packages are intended to be used in conjunction with the other architecture documents. In particular, the introductory chapters of the Standards Requirements Document provide contextual material and explanations/justifications of some of the methods used to evaluate and rate architecture flows. However, it is recognized that many people may initially only receive a given Standards Requirements Package, without the associated supporting material. To aid these individuals, we offer some generic introductory material to promote understanding of the context and approach used to create a Standards Requirements Package. Ultimately, any standards development organization pursuing an ITS-related standard should ensure that they have access to a complete set of the architecture documents as a reference source.

1.1 Standards Requirements Document Executive Summary

The executive summary of the Standards Requirements Document is reproduced here, to provide a sense of the overall goals and content of the document.

The Standards Requirements Document ("SRD") collects information from the other National ITS Architecture program documents and reorganizes it in a manner intended to support the development of critical ITS standards. The key results in the SRD are a reference model for the National ITS Architecture, a rating scheme for evaluating the standardization issues associated with individual data flows that make up the architecture interfaces, and then a set of priority groupings of interfaces into standards requirements "packages". These results and the major conclusions are summarized below.

The introductory section explains the structure of the SRD and its intended usage. The strategy is that the reference model provides the overall context for a standards development organization ("SDO"). A given SDO can pull a particular package of standards requirements out of the document and then use the reference model as a quick reference to the overall architecture. More detailed needs will require going to the original source documents, such as the Logical or Physical Architectures.

The next section provides the rationale for several different ratings schemes applied to the architecture interconnects and flows. These include interoperability requirements, technology maturity assessments, stakeholder interest. All architecture interconnects were examined with respect to these measures. The stakeholder interest and interoperability requirements in particular were then used as the basis for selecting the standards requirements packages. In general, interfaces associated with mobile systems had both the greatest stakeholder interest and the most stringent interoperability requirements. Following close behind were interfaces associated with Traffic Management and Information Service Provider subsystems.

The Architecture Reference Model is provided next as a high level definition of the components that form the National ITS Architecture. It depicts the interconnectivity of the subsystems and terminators, their definitions, and suitable types of communications strategies. This reference model is an important tool for communicating the full breadth of the architecture at an abstracted level. In the SRD it is intended as a contextual reference, but, as a separate document, the reference model has received international circulation through the International Standards Organization (ISO) as a basis for documenting and comparing ITS architectures.

The "meat" of the SRD is the set of standards requirements packages. Each package is a special grouping of standards requirements and contextual information intended to be used in a nearly standalone fashion by an SDO. Thus, packages have been selected that cover the key ITS priorities, maintain the integrity and vision of the National ITS Architecture, and also are perceived as having an interested stakeholder constituency that will help drive standardization. This is a difficult balancing act, but the following 13 packages were identified as covering the high priority standardization needs for the architecture program:

1. Dedicated Short Range Communications (DSRC, formerly "VRC")
2. Digital Map Data Exchange and Location Referencing Formats
3. Information Service Provider Wireless Interfaces
4. Inter-Center Data Exchange for Commercial Vehicle Operations
5. Personal, Transit, and HAZMAT Maydays
6. Traffic Management Subsystem to Other Centers (except EMS)
7. Traffic Management Subsystem to Roadside Devices and Emissions Monitoring
8. Signal Priority for Transit and Emergency Vehicles
9. Emergency Management Subsystem to Other Centers
10. Information Service Provider Subsystem to Other Centers (except EMS and TMS)
11. Transit Management Subsystem Interfaces
12. Highway Rail Intersections (HRI)
13. Archive Data Management Subsystem Interfaces

These 13 areas cover much of the National ITS Architecture and represent the distillation of stakeholder interests and architecture interoperability requirements. If standardization can be achieved in the near term for all or most of these packages, then ITS will be a long ways towards achieving the original vision captured in the user service requirements.

1.2 Constructing a Standards Requirements Package

The intent of creating a Standards Requirements Package is to facilitate efforts to standardize some subset of the National ITS Architecture. The "packaging" process involves abstracting and reorganizing information from other documents, primarily the Logical and Physical Architectures. We have gone through a number of iterations to try and achieve a format that is understandable and useful for SDO's; in the end, while there is not a universal consensus, we have tried to address the substance of most of the comments received.

This Standards Requirements Package has the following main components:

- General introduction to the scope and intent of this package
- Message transaction sets
- Decomposition of the interfaces
- Communications Considerations
- Constraints
- Leveled Data Item definitions

The general introduction is self-explanatory, but the other items require some explanation. We will address them one at a time:

Message Transaction Sets: In order to accomplish a given activity, a series of messages usually have to be exchanged between two or more subsystems. These messages, as a group, constitute a message transaction set. The sequencing of the messages is shown via an ISO-style message sequence chart.

Typically the physical architecture flow or highest level logical architecture data flows represent individual messages.

Interface Decomposition: This is the hierarchy of items that constitute an interface. It starts with the interface between two subsystems itself, which is then decomposed into physical architecture flows. Each of the physical architecture flows is then decomposed into a set of Leveled Architecture Flows. These sets of flows have been created in order to capture the essential information described by the National ITS Architecture on each Subsystem interface of interest. The Leveled Architecture Flows can be thought of as a simplified view of the logical architecture information, removing aggregation of data which does not add value to describing the essential information on the interface, and removing some of the lower level details in the existing data flows. These leveled architecture flows are traceable to flows in the logical architecture. The physical architecture data flows are labeled with the type of communications technology appropriate for that flow. Figure 1 shows an example of an interface decomposition. The leveled data items represent a simplification of the logical architecture information to focus on the essential data on each subsystem interface. They have been developed in order to provide traceability between the ITS standards being developed and the National ITS Architecture. Once a draft standard has been developed, the question that must be addressed is whether the standard addresses completely all elements of the National ITS Architecture interface. Due to the complex hierarchical nature of the Logical Architecture data flows, comparison with standards outputs is very difficult. By creating a simplified view of each interface, it is possible to more effectively trace the standards outputs to the National ITS Architecture.

Communications Considerations provides a discussion of the basic nature of the communications modalities that are suitable for supporting the interfaces in the particular standards requirements package. This section identifies some high level requirements, but the primary focus is to provide information that is viewed as useful to the initiation of the standardization process.

Constraints lists the architecture flows and any constraints placed upon them.

Leveled Data Items: This section provides a set of definitions for each of the leveled data elements included in the Interface Decomposition section. These definitions are simplified versions of the definitions contained in the Logical Architecture Data Dictionary, providing just the essential information to define the key elements of a subsystem interface.

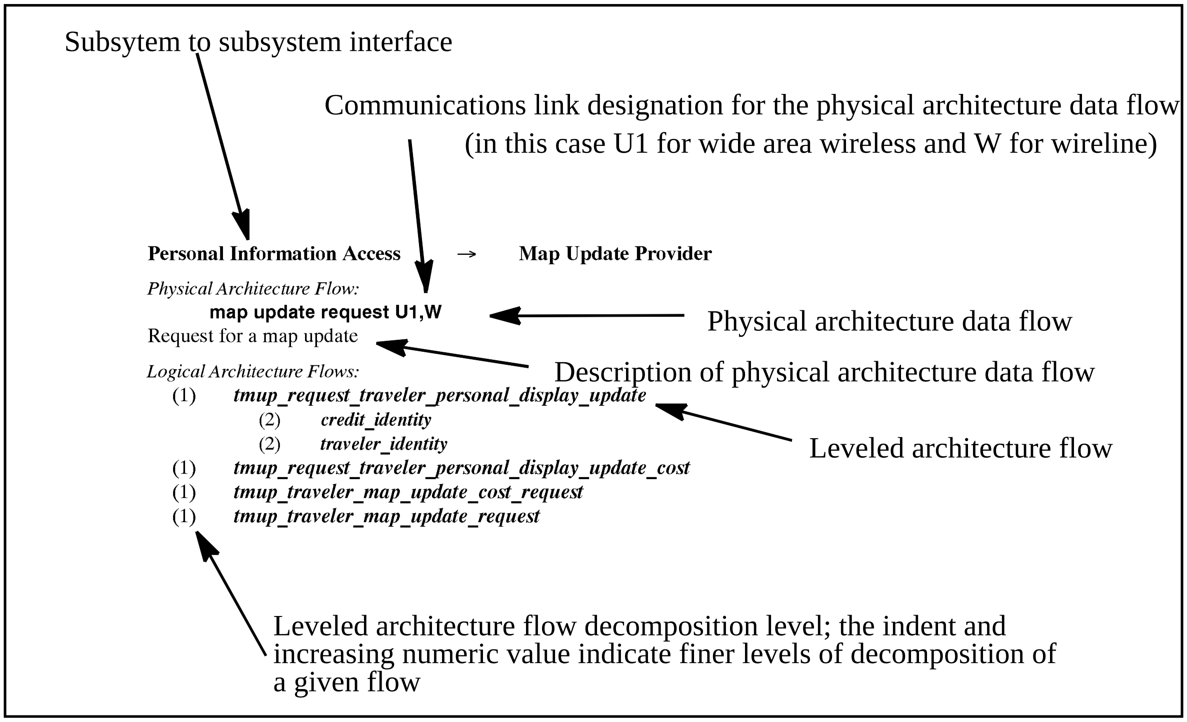

Figure 1 - Example of the parts of an interface decomposition

As a final clarification, it is useful to remind readers of the distinction between the layers in the ISO OSI communications reference model and the layers in the National ITS Architecture. For purposes of analysis and discussion, the National ITS Architecture has been portrayed as having three layers: *the transportation, the communications, and the institutional layer*. The first two are of concern here. The transportation layer contains all the functionality of the National ITS Architecture. As a consequence, any discussion of interfaces, messages, data dictionary entries, etc., is drawn from the information in the transportation layer. The communications layer describes the technology required to support the information exchange needs of the transportation layer. These National ITS Architecture layers can be roughly mapped to the ISO OSI reference model; the transportation layer is typically at or above the application layer and the communications layer is most often concerned with the lowest four layers of the ISO OSI reference model. The interested reader is directed to the Communications Analysis Document for a more substantial explanation of this relationship.

This explanation of the layers is offered here because the terminology can be confusing. Every effort has been made to clarify when the "layered model" is the National ITS Architecture and when it is the OSI reference model. In general, when the term "communications layer" is used in the Standards Requirements Document, it refers to the National ITS Architecture "layer".

2 Introduction to this Standards Package

This standards requirements package covers the interfaces between the Emergency Management Subsystem and the rest of the architecture for the purpose of sending Mayday messages. The subsystems which originate and send Mayday messages directly to the Emergency Management (EM) are the Vehicle Subsystem, the Personal Information Access Subsystem (PIAS), and the Remote Traveler Subsystem (RTS). Hazmat related Mayday is covered as a special case of the Vehicle Subsystem Mayday.

Two additional interfaces are covered by this Package -- the Transit Management Subsystem (TRMS) to EM interface and the Fleet Management Subsystem to EM interface. The TRMS interface is for forwarding of Maydays received from Transit Vehicles or kiosks at transit stops, which the TRMS decides requires EM notification or assistance. The FMS interface is for the transmittal of HAZMAT information to the EM, either prior to a HAZMAT trip, or after an incident concerning a HAZMAT has occurred.

From a standardization viewpoint, the Vehicle to EM and PIAS to EM interfaces have national interoperability requirements and are candidates for early standards development. These interfaces are via wide area wireless, and a standardization of not only the application layer messages, but also the communication layer protocols is important to the nationwide deployment of the Mayday function. The remaining interfaces will be wireline and while they do not require standardization at the communications level, there is a benefit to coordinating the messages at the application layer.

All three direct Mayday interfaces have the concept of a user initiated request. In addition, an acknowledgment message by the EM is also a key requirement. The Vehicle Subsystem Mayday also has the functionality (for use in future systems) of generating an automatic MAYDAY based upon sensor information in the vehicle.

The subsystems and the physical architecture data flows that are applicable to this standards package are shown in Figure 2.

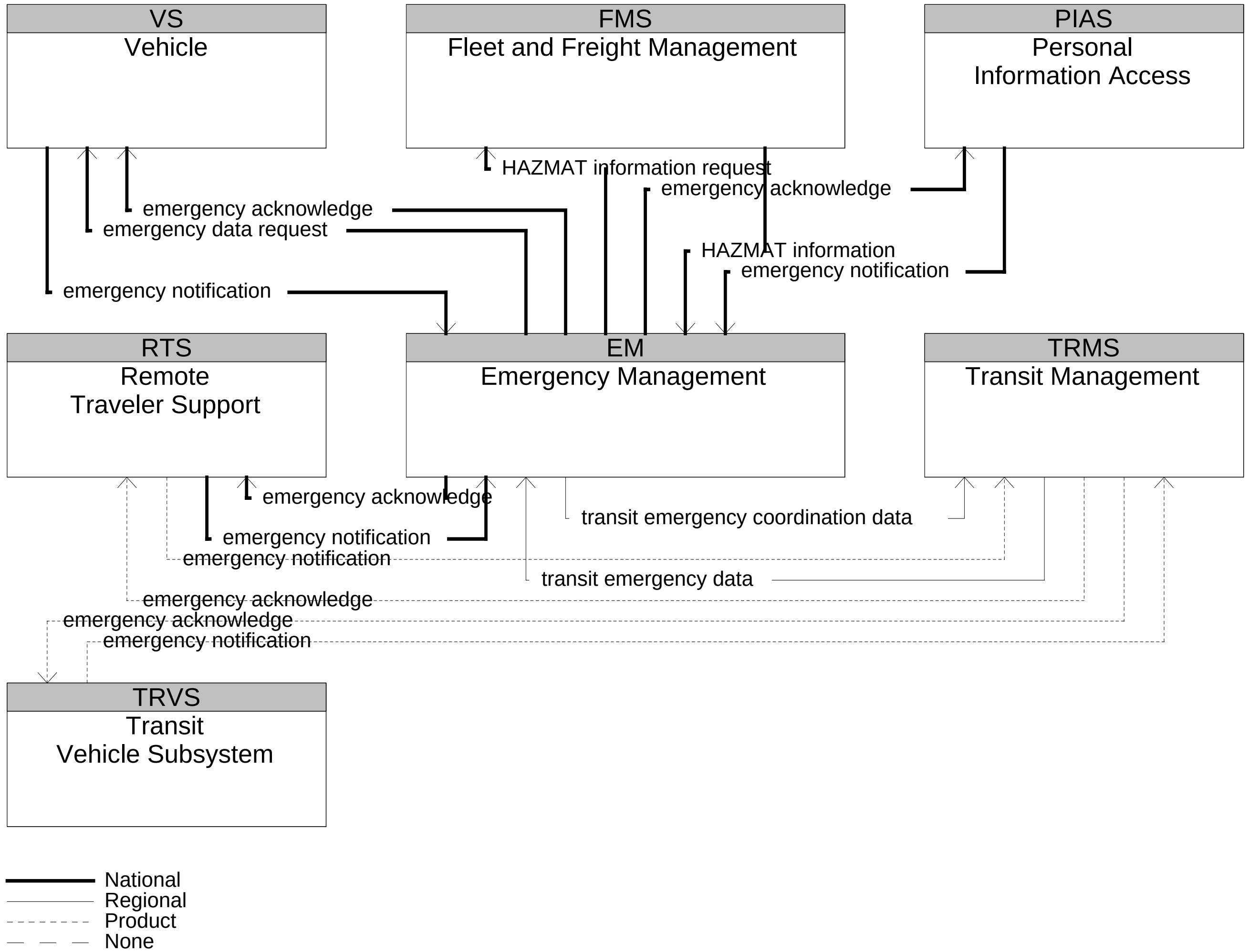

Figure 2 - Architecture Flows for Personal, Transit, and HAZMAT Maydays

3 Transaction Sets for the MAYDAY Interfaces to Emergency Management

In this section we define the transaction sets needed to accomplish different ITS tasks. A message sequence chart format along the lines of those defined under ISO standardization is used for clarity of presentation. The following subsections discuss the interactions between the Emergency Management Subsystem (EM) and the subsystems that interface with it for MAYDAY functionality.

The transaction set figures used in this chapter identify the messages (shown as logical architecture data flows) that go between the subsystems. Where messages follow each other top to bottom, they represent a transaction sequence or protocol. Where messages are separated by a horizontal dotted line, the messages are distinct, and not related in any particular sequence.

3.1. Fleet Management

Once the EM has learned about a HAZMAT incident, it sends a request to the Fleet and Freight Management Subsystem (FMS) for information about route and nature of HAZMAT load. The FMS responds with the requested information. This allows the EM to determine an appropriate response to the HAZMAT incident.

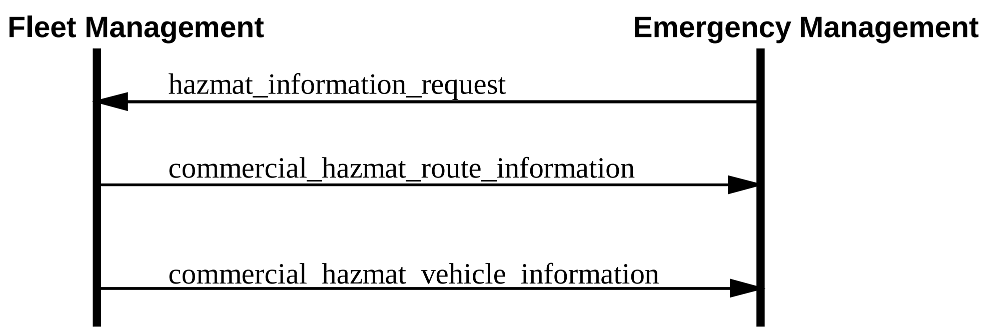

Figure 3 - Fleet and Freight Management and Emergency Management Transaction Set

3.2. Personal Information Access

The Personal Information Access Subsystem (PIAS), which is a mobile system that provides access to ISP services, TMS traffic information, and other services, can also provide a MAYDAY connection to EM. Since this device is mobile, an unambiguous location reference is required and is contained in the emergency information message. Upon receipt of the message the EM sends an acknowledgment.

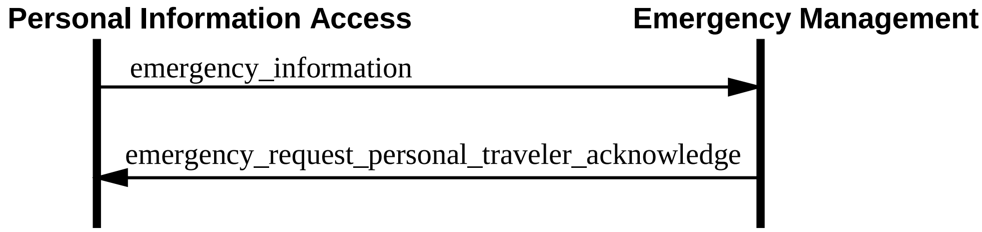

Figure 4 - Personal Information Access and Emergency Management Transaction Set

3.3. Remote Traveler Support

The Remote Traveler Support Subsystem (RTS) can manifest itself as a kiosk, which provides access to ISP services, TMS traffic information, and other services. This kiosk also provides a MAYDAY connection directly to the EM (see the first figure below), or indirectly through TRMS to the EM. This device is at a fixed location, so although a location parameter is transmitted, there is no need for a location sensing device in the kiosk. The EM will respond with an acknowledgment. Other types of information reporting devices may be used by the traveler requesting assistance, such as, an in-vehicle or personal device, or video, audio, or panic button at a transit stop or depot. This is illustrated in the second figure below.

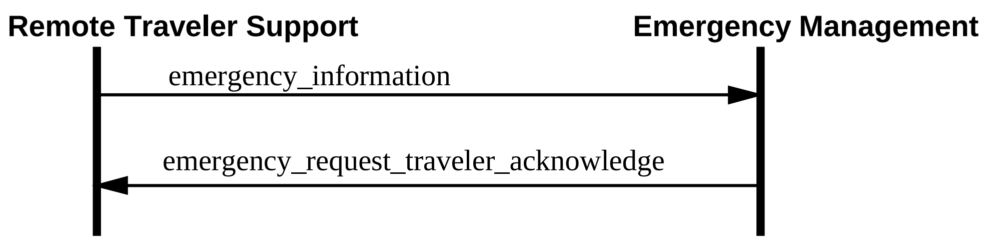

Figure 5 - Remote Traveler Support and Emergency Management Transaction Set

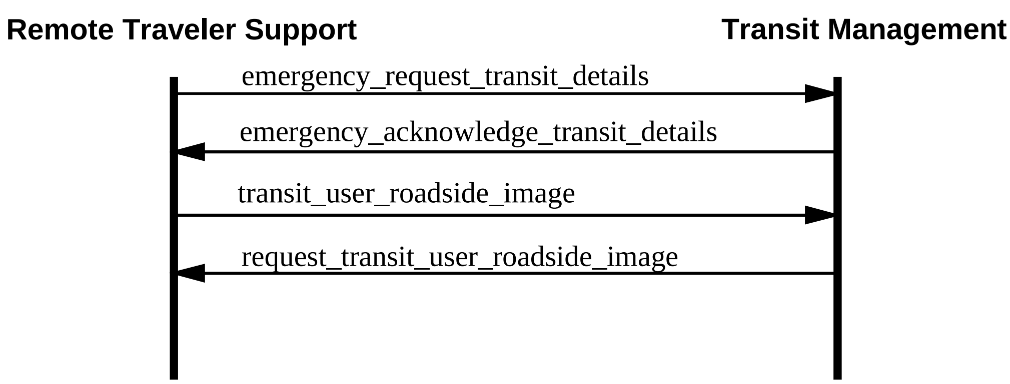

Figure 6 - Remote Traveler Support and Transit Management Transaction Set

3.4. Transit Management

The Transit Management Subsystem (TRMS) receives emergency alarms from travelers waiting at transit stops, passengers on vehicles, or vehicle operators. TRMS evaluates these alarms and if necessary requests assistance from EM. The TRMS may send information about an emergency in a transit vehicle (data flow "transit emergency data") or information about an emergency at a transit stop or somewhere else in the transit system (data flow "transit incident details"). The EM may respond by providing coordination information to the TRMS. The interchange of coordination information may continue any number of times. The transactions shown between TRMS and the Transit Vehicle or transit stop are a general flow of information (not the specific logical architecture data flows). A more detailed depiction of this interface is contained in Package 11: Transit Management Subsystem Interfaces. The alarm is initiated and the TRMS acknowledges the alarm. As part of that acknowledgment, the TRMS may request video images, which are then sent.

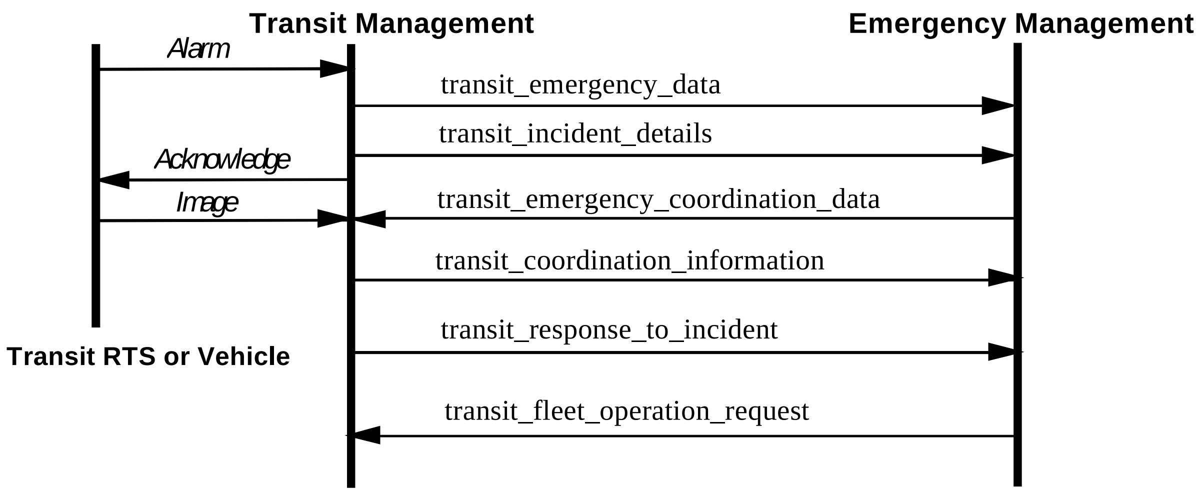

Figure 7 - Transit Management and Emergency Management Transaction Set

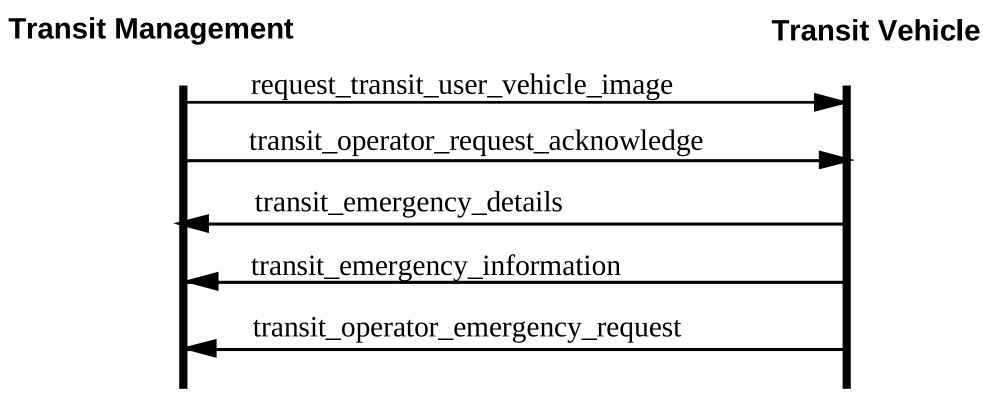

Figure 8 - Transit Management and Transit Vehicle Transaction Set

3.5. The Vehicle Subsystems

The MAYDAY from the vehicle subsystem comes in two flavors: a driver personal emergency (crime, health, etc.) and a vehicle platform MAYDAY (due to a crash or other incident). It is quite possible an accident might lead to the issuance of both types of MAYDAY's. A commercial HAZMAT vehicle

MAYDAY is covered by the vehicle subsystem MAYDAY, and would use the same reporting communication techniques as a personal vehicle.

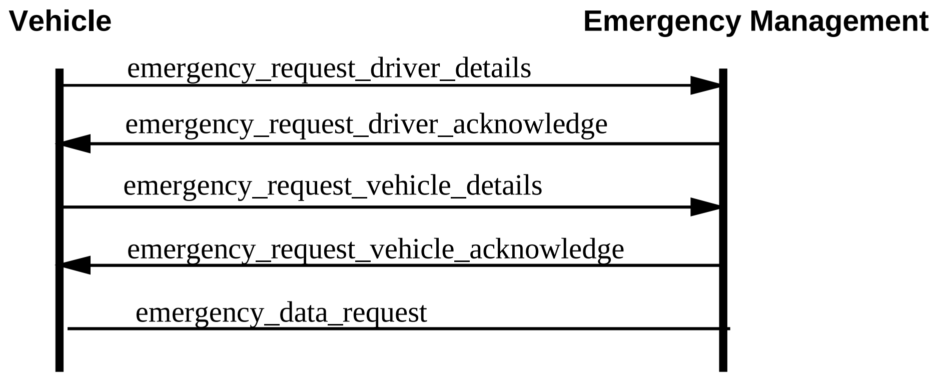

Figure 9 - Vehicle and Emergency Management Transaction Set

4 Interface Decomposition

This section shows the interface decomposition for the interfaces covered in this package. The format shows the interface followed by the first physical architecture data flow in the interface and its description. Each of the physical architecture flows is then decomposed into its constituent leveled data items, which in turn are decomposed hierarchically into more basic leveled architecture flows. The leveled data items are numbered and indented to indicate which are top level flows (1) and which are constituent data flows (numbered 2 and lower). The description of the top level leveled data item is given. The full leveled data item definition for the top level flows and for all the constituent flows is given in Section 7. That section contains the leveled data item entries, listed in alphabetical order, for all of the leveled data items contained in this package. The leveled data items represent a simplification of the logical architecture information to focus on the essential data on each subsystem interface. They are traceable to the original logical architecture data elements, and have been developed in order to provide traceability between the ITS standards being developed and the National ITS Architecture. Once a draft standard has been developed the question that must be addressed is whether the standard completely addresses all elements of the National ITS Architecture interface. Due to the complex hierarchical nature of the Logical Architecture data flows, comparison with standards outputs is very difficult. By creating a simplified view of each interface, it is possible to more effectively trace the standards outputs to the National ITS Architecture.

4.1 Fleet and Freight Management -> Emergency Management

Physical Architecture Flow: **Hazmat information** W
Information about a particular hazmat load including nature of the load and unloading instructions. May also include HAZMAT vehicle route and route update information

Leveled Architecture Flows:

(1) ***commercial_hazmat_route_information***
This data item contains information about the route about to be used or planned for a commercial vehicle that will carry hazardous materials. This information may cause the Emergency Services to raise an incident for all or part of the vehicle's route.

(2) ***commercial_route_number***

(2) ***route_cost***

(2) ***route_list***

(2) ***route_segment_description***

(2) ***route_segment_end_point***

(2) ***route_segment_estimated_arrival_time***

(2) ***route_segment_estimated_condition***

(2) ***route_segment_estimated_travel_time***

(2) ***route_segment_identity***

(2) ***route_segment_mode***

(2) ***route_segment_predicted_weather***

(2) ***route_segment_start_point***

(2) ***route_start_time_date***

(2) ***route_statistics***

(1) ***commercial_hazmat_vehicle_information***
This data item contains information about hazardous materials that are on-board the vehicle and details of the vehicle itself.

(2) ***hazmat_load_data***

(2) ***hazmat_vehicle_data***

4.2 Personal Information Access -> Emergency Management

Physical Architecture Flow: emergency notification U1t
An emergency request for assistance originated by a traveler using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the emergency as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the emergency may also be provided (and required) by some systems.

Leveled Architecture Flows:

(1) ***date***
This data item specifies a calendar date that is normally used to indicate currency or effectivity of other data.

(1) ***emergency_information***
This data item provides information about current incidents.

(1) ***time***
This data item contains the current time of day and will be associated with other data items and (possibly) a date.

4.3 Remote Traveler Support -> Emergency Management

Physical Architecture Flow: emergency notification W,U1t
An emergency request for assistance originated by a traveler using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the emergency as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the emergency may also be provided (and required) by some systems.

Leveled Architecture Flows:
(1) ***date***
This data item specifies a calendar date that is normally used to indicate currency or effectivity of other

data.

(1) ***emergency_information***
This data item provides information about current incidents.

(1) ***time***
This data item contains the current time of day and will be associated with other data items and (possibly) a date.

4.4 Transit Management -> Emergency Management

Physical Architecture Flow: transit emergency data W
Initial notification of transit emergency at a transit stop or on transit vehicles and further coordination as additional details become available and the response is coordinated.

Leveled Architecture Flows:

(1) ***incident_duration***
This data item contains the expected duration of an incident from its start time until the time at which it is expected that it will have no further effect on traffic conditions.

(1) ***incident_location***
This data item contains the location at which an incident will take place (for planned events) or is taking place (for current incidents).

(1) ***incident_severity***
This data item identifies the severity of an incident.

(1) ***incident_start_time***
This data item contains the incident start time.

(1) ***transit_coordination_information***
This data item contains incident response coordination information for use by processes in that function.

(1) ***transit_emergency_data***
This data item contains details of an emergency on-board a transit vehicle.

(2) ***incident_duration***

(2) ***incident_location***

(2) ***incident_severity***

(2) ***incident_start_time***

(1) ***transit_incident_details***
This data item contains details of an incident in the transit operations network.

(2) ***incident_duration***

(2) ***incident_location***

(2) ***incident_severity***

(2) ***incident_start_time***

(1) ***transit_response_to_incident***
This data item contains details of what transit action is required in response to an incident. It is used by processes within that function.

4.5 Vehicle -> Emergency Management

Physical Architecture Flow: emergency notification U1t
An emergency request for assistance originated by a traveler using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the emergency as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the emergency may also be provided (and required) by some systems.

Leveled Architecture Flows:

(1) ***call_back_information***
This data item allows travelers involved in an incident to reestablish and continue communications with an emergency management system after initial contact has been made and ended. This could be something similar to the driver's mobile phone number.

(1) ***date***
This data item specifies a calendar date that is normally used to indicate currency or effectivity of other data.

(1) ***driver_information***
This data item is used to convey information about the driver. The emergency service providers can dispatch emergency vehicles that will be prepared to give the kind of attention required in each particular situation. Information such as the driver's name, license number, or information about the driver's personal medical history may be included in this data item. Use of this field is voluntary and it should not be coded without the explicit consent of the driver.

(1) ***emergency_request_vehicle_details***
This data item sends data about an emergency automatically declared by a vehicle to the Manage Emergency Services function.

(2) ***date***

(2) ***processed_cargo_data***

(2) ***time***

(2) ***vehicle_crash_sensor_data***

(2) ***vehicle_security_status***

(2) ***vehicle_system_status***

(1) ***location_identity***
This data item contains the location of any transportation feature, entity, or event in an unambiguous and mutually understandable way.

(1) ***time***
This data item contains the current time of day and will be associated with other data items and (possibly) a date.

(1) ***vehicle_identity***
This data item contains the identity of a vehicle.

4.6 Emergency Management -> Fleet and Freight Management

Physical Architecture Flow: Hazmat information request W
Request for information about a particular hazmat load.

Leveled Architecture Flows:

(1) ***hazmat_request***
This data item contains a request for information about hazardous materials that are being or about to be carried by commercial vehicles.

4.7 Emergency Management -> Personal Information Access

Physical Architecture Flow: emergency acknowledge W,U1t
Acknowledge request for emergency assistance and provide additional details regarding actions and verification requirements.

Leveled Architecture Flows:

(1) ***emergency_request_personal_traveler_acknowledge***
This data item confirms that the request for emergency services previously sent by the traveler has been received from a personal device and is therefore sent to the Provide Driver and Traveler Services function for output.

4.8 Emergency Management -> Remote Traveler Support

Physical Architecture Flow: emergency acknowledge W,U1t
Acknowledge request for emergency assistance and provide additional details regarding actions and verification requirements.

Leveled Architecture Flows:

(1) ***emergency_request_traveler_acknowledge***
This data item is used to confirm that the request for emergency services previously sent by the traveler has been received from a kiosk or other device.

4.9 Transit Management -> Remote Traveler Support

Physical Architecture Flow: emergency acknowledge W
Acknowledge request for emergency assistance and provide additional details regarding actions and

verification requirements.

Leveled Architecture Flows:

(1) ***emergency_acknowledge_transit_details***
This data item is used to confirm that the request for emergency services previously sent by the traveler has been received from a kiosk or other device. This data item may also contain the response to input from a panic button that has been activated by a transit user in part of the transit operational network, i.e. not on-board a transit vehicle, or at a transit stop, but in such things as a modal interchange facility, transit depot, etc. The information will be sent out as part of the response to an emergency or incident being detected within the network.

(1) **r*equest_transit_user_roadside_image***
This data item contains a request for the supply of the image of a transit user who has violated the transit fare payment process at a roadside fare collection point.

4.10 Emergency Management -> Transit Management

Physical Architecture Flow: transit emergency coordination data W
Data exchanged between centers dealing with a transit-related incident.

Leveled Architecture Flows:

(1) ***transit_coordination_information***
This data item contains incident response coordination information for use by processes in that function.

(1) ***transit_fleet_operation_request***
This data item contains a request for the transit system operator to take specified actions in response to an incident.

(1) ***transit_response_to_incident***
This data item contains details of what transit action is required in response to an incident. It is used by processes within that function.

4.11 Remote Traveler Support -> Transit Management

Physical Architecture Flow: emergency notification W
An emergency request for assistance originated by a traveler using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the emergency as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the emergency may also be provided (and required) by some systems.

Leveled Architecture Flows:

(1) ***emergency_request_transit_details***
This data item is used to send data about an emergency declared by a traveler at a transit stop using a kiosk or other device. This can also be used by the transit user to alert the transit system operator to an emergency situation or incident within the transit operational network, i.e. not on-board a transit vehicle,

or at a transit stop, but in such things as a modal interchange facility, transit depot, etc.

(2) ***traveler_identity***

(2) ***traveler_location_for_emergencies***

(1) ***transit_user_roadside_image***
This data item contains a compressed image of the transit user who has violated the transit fare collection process at the roadside, i.e. at a transit stop. The data will be used in subsequent transit fare violation processing.

4.12 Transit Vehicle Subsystem -> Transit Management

Physical Architecture Flow: emergency notification U1t
An emergency request for assistance originated by a traveler using an in-vehicle, public access, or personal device. Sufficient information is provided so that the recipient can determine the location of the emergency as a minimum. Additional information identifying the requestor and requesting device and the nature and severity of the emergency may also be provided (and required) by some systems.

Leveled Architecture Flows:

(1) ***transit_emergency_details***
This data item contains details of emergency requests that have been input on-board a transit vehicle.

(2) ***transit_driver_emergency_request***

(2) ***transit_user_emergency_request***

(2) ***transit_vehicle_location***
(3) ***transit_vehicle_identity***

(3) ***transit_vehicle_location_data***

(1) ***transit_emergency_information***
This data item contains details of emergency requests that have been input on-board a transit vehicle.

(2) ***transit_driver_emergency_request***

(2) ***transit_user_emergency_request***

(2) ***transit_vehicle_location***
(3) ***transit_vehicle_identity***

(3) ***transit_vehicle_location_data***

(1) ***transit_operator_emergency_request***
This data item contains information about an incident that has been detected on board a transit vehicle or at a transit facility following input from a transit user or transit vehicle driver.

4.13 Transit Management -> Transit Vehicle Subsystem

Physical Architecture Flow: emergency acknowledge U1t
Acknowledge request for emergency assistance and provide additional details regarding actions and verification requirements.

Leveled Architecture Flows:

(1) ***request_transit_user_vehicle_image***
This data item contains a request for the supply of the image of a transit user who has violated the transit fare payment process at an on-board vehicle fare collection point.

(1) ***transit_operator_request_acknowledge***
This data item contains an acknowledgment that the previous notification of an emergency to the transit system operator has been received and is being considered for action.

4.14 Emergency Management -> Vehicle

Physical Architecture Flow: emergency acknowledge U1t
Acknowledge request for emergency assistance and provide additional details regarding actions and verification requirements.

Leveled Architecture Flows:

(1) ***emergency_request_driver_acknowledge***
This data item acknowledges that the request for emergency services previously sent by the driver has been received.

(1) ***emergency_request_vehicle_acknowledge***
This data item acknowledges that the request for emergency services previously sent automatically by the vehicle through processes in the Provide Vehicle Control and Monitoring function has been received.

Physical Architecture Flow: emergency data request U1t
A request for additional information or a control command issued by the emergency response agency in response to an emergency request for assistance from a traveler.

Leveled Architecture Flows:

(1) ***emergency_data_request***
This data item allows an emergency service provider to request additional information from the vehicle following emergency notification. It allows the vehicle and driver to carry on a continuous dialogue with and emergency operator to make sure that the emergency service providers have the information they need to be well prepared to handle the incident. It shall also allow the travelers of a vehicle to request operation of remote controlled security functions of a vehicle such as a door unlocking function.

(2) ***request_for_additional_data***

(2) ***vehicle_security_system_commands***

5 Communications Considerations

This chapter describes relevant requirements and information regarding the portion of the Communications Layer of the ITS National Architecture covered by this package. In general the Communications Layer supports the four lower layers of the OSI model (transport, network, data link, and physical layer). A complete description of the Communications Layer is contained in the ITS National Architecture Communications Analysis Document.

For this standards requirements package there are two relevant communication types: Wireline communications (w) and two-way wireless (u1). Each of these communication types will be discussed and the architecture flows that are mapped to each communication type are defined (see Section 6.2.).

5.1 Communications Services: Wireline and Wireless

The communication services define the exchange of information between two points and are independent of media and application (i.e., ITS user service). In essence, they are a specified set of user-information transfer capabilities provided by the communication layer to a user in the transportation layer.

Communication services consist of two broad categories, *interactive* and *distribution*. Interactive services allow the user to exchange data with other users or providers in real or near real time, asking for service or information and receiving it in the time it takes to communicate or look up the information. Distribution services allow the user to send the same message to multiple other users.

Interactive services may be either ***conversational*** or ***messaging***. Conversational implies the use of a two-way connection established before information exchange begins and terminated when the exchange is completed. Messaging, on the other hand, works more like electronic mail being exchanged between users. The messages are exchanged without establishing a dedicated path between the two sites. Each message is addressed and placed on the network for transmission, intermixed with messages from other users. The communications community labels this mode of communication a "datagram" service.

Distribution services may be either ***broadcast*** or ***multicast*** and may be used over wireline and/or wireless communication links. Broadcast messages are those sent to all users while multicast messages are sent only to a subset of users. Multicast differs from broadcast in its use of a designated address for all users and user groups. Examples of broadcast information might include current weather or road conditions, whereas multicast information might be information sent to all drivers working for a specific company. A changing group membership could be the set of users traveling between two locations or with a certain destination, for which unique information must be transmitted. The services that can be supported using circuit or packet connection mode include voice, video, image, and data. (See Appendix A-1 of the communication document for a complete description.)

An additional class of communications services includes location services. These fall in two categories: (1) the services that do not use the communication network (i.e., GPS, and stand alone terrestrial systems); (2) location services that use the network for providing the service (e.g., cellular based systems). In the latter case, the location services fall under the interactive services. The service will be rendered by a service provider in response to a request for information or help.

The class of communications service for each Architecture Flow in this standards package is defined in a table in the following section.

5.2 Wireline Communication Elements (w)

The primary requirements for the wireline communications layers include the utilization of open standards for the communications protocols. The following paragraphs provide a discussion of wireline considerations for ITS.

The wireline links represent wide area network communications elements, which can take a number of forms. Typically it will be a data network of some kind. Physically the network can be fiber, coaxial, twisted pair, or even microwave. It can be an ITS dedicated network, such as a communication system installed by a public agency to pass messages between a Roadside Check Station and the CVAS. Alternatively it can be a privately deployed network owned and operated by a communication service provider, where operators of ITS subsystems pay a service fee for connection to and use of the network or lease the lines. More than one network used for ITS may coexist in a region, and these networks will be connected (or internetworked) to support ITS message communication between subsystems that are attached to different networks.

It is expected that the current trend toward ubiquitous internetworking of public and private data networks, as currently embodied in the "Internet", for example, will continue. This will enable inter-subsystem messaging across local, regional and national distances. What the Internet is rapidly evolving into (as security and reliability issues of today's Internet are addressed) has been referred to as the "National Information Infrastructure"or "NII".

In the near term, we expect that many communication elements will be dedicated, as they primarily are today. As commercial data networks are deployed, interconnected, and mature, and the cost of access and use of these private data networks drops, we expect more and more wireline networks for ITS to be supplied from Communication Service Providers (CSP's). The time when the transition from private data networks to commercial data networks becomes practical and economical will vary by region. We expect this transition to be analogous to the transition that was made early in this century from private phone networks to the Public Switched Telephone Network (PSTN). Our expectation is that in the 20-year time frame most ITS communication will be provided by CSP's.

In the area of center to center communications there are several existing and developing communications standards to choose from. These include ATM, Frame Relay, MAN (IEEE 802.6), and FDDI. At the network layers TCP/IP is a widespread standardized protocol. The key is that by using standard communication protocol suites the regional integration of the wireline data shown above will most readily be accomplished. One of the developing ITS standards for wireline communications is the National Transportation Communications for ITS Protocol (NTCIP). This standard is being developed for the transmission of data and messages between ITS elements. The initial version of the NTCIP is being developed to support the interface from the TMS to traffic controllers and DMS signs. Work is underway to extend this to other roadside equipment. Plans are also in place to extend the protocol for center to center communications.

5.3 Wireless Communication Elements (u1)

Given the ITS goal of seamless nationwide wireless services, the following three requirements can be stated for any wireless wide area network (WAN) communication elements:

1. The interfaces use open standards.

[This guarantees that ITS subsystem equipment from many competing manufacturers can be used to connect the communications element. The cost of the data communication module (e.g., modem, transceiver) should be small relative to the ITS subsystem.]

2. The communication element be internetworked with other communication elements.

   [The communication element provider must participate in the open internetworking standards that enable messaging between users of different communication element technologies.]

3. The communication element be nearly ubiquitous to the nation or at least a region.

   [This enables users to "roam" over a substantial area of user interest and have seamless access to ITS services. The roaming capability is supported by the communication service provider.]

Exceptions will be found for specific deployments where legacy communication systems need to be accommodated, or where some of the interoperability related benefits of ITS are not important (e.g., dedicated regional safety or transit services). It is expected in these cases that the capability to interface to open systems (through the wireline networks) to allow information exchange will still be possible.

The rest of this chapter is a discussion of how the WAN wireless communication elements will function within the architecture and is informational rather than requirements based.

The wide area network (WAN) wireless communication element can be dedicated to a specific user or agency (and publicly owned or privately owned), or it can be privately owned and operated by a communication service provider who sells access to this data network to many users or agencies for a fee.

A key feature of most wireless communication elements is that they are or can be internetworked to a wireline communication system of some sort. In this way, mobile units can exchange ITS messages with Center or Roadside subsystems. We assume and require that the 2-way ITS wireless communication network will have the necessary coverage for a particular user service application, and that the wireless network will be internetworked to the wireline wide area communications network. The following sections discuss various options that might be deployed.

Wireless communication systems can be one-way (broadcast) or two-way. For broadcast systems, an example is FM-subcarrier systems. Two-way systems that are private include SMR (Special Mobile Radio) or E-SMR (Enhanced SMR). SMR and E-SMR require licenses from the FCC for operation, and are typically dedicated to a specific service or agency.

Dedicated and Shared Communications

We think it likely that in the 20-year timeframe, Wide Area Network (WAN) data communications will have become largely a commodity with many competing suppliers of wireline and 2-way wireless services. As a commodity, the ITS Subsystems will use whatever WAN communication service is available that meets the operators' needs at the lowest price.

Today, since the commoditization of WAN 2-way data communications is still in its early stages, many ITS early deployments and Field Operational Tests (FOT's) properly use dedicated WAN systems or one-way FM-subcarrier and pager systems. The architecture supports both private and shared deployments as appropriate.

Architecture Robustness to Spatially Different Deployments

This section discusses how different deployments (Urban, Interurban, and Rural) of the architecture will interoperate. Specific focus on the strategy for mobile subsystems will be discussed.

Figure 10 shows how a large number of Communication Service Providers (CSP's) both internetwork themselves together and connect to their clients, thus provide any-to-any messaging for their clients to and from any other clients on the set of internetworked CSP's. This is, at a very high level, how the Internet functions today, and how the NII will function in the future.

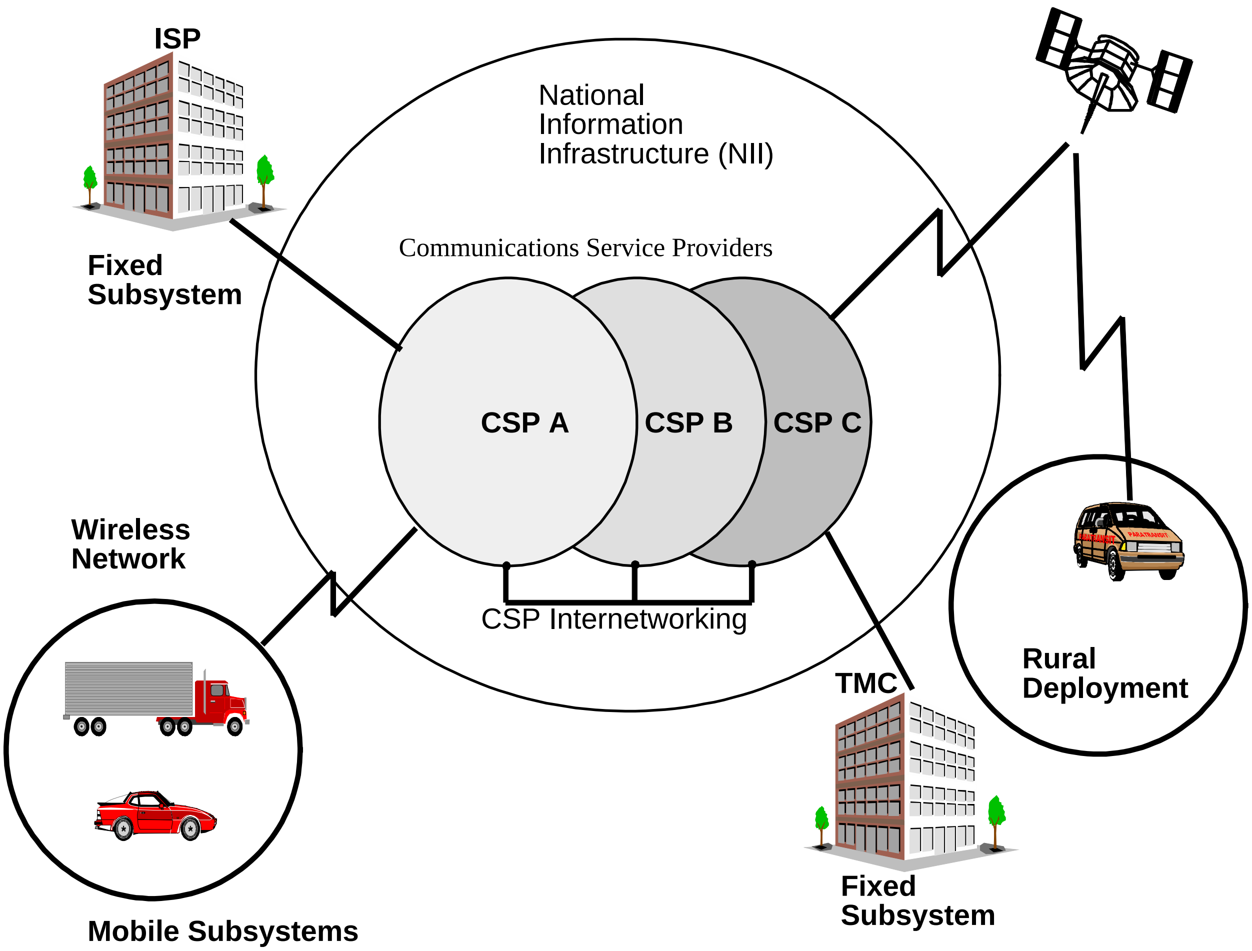

Figure 10 - ITS Communications Network Topology

The key feature of this system is that the clients can connect to their chosen CSP with any technology, wireline or wireless, and send messages to any other client of any other CSP, independent of the technology that they have chosen to connect with.

Mobile clients will be able to "roam", that is, move geographically anywhere that their service provider offers service, and be able at any time to send or receive data messages. This capability already exists for the Advanced Mobile Phone System (AMPS), and will be extended for the emerging data services based on the same cell-based communication technologies. Mobile data service providers can be expected to make arrangements with providers out of their area to reciprocally give their clients roaming privileges outside of their "home" areas, thus extending mobile connectivity across the country.

Institutionally, the clients have a choice of CSP's to choose from. Competition for clients will result in aggressive pricing and technology deployments by the CSP's, leading the commoditization of wireline and wireless communications referred to earlier.

Figure 11 shows that ISP's use wireline and wireless communications to provide services to their clients (including Transit Vehicles and Emergency Vehicles for Publicly operated ISP's). Figure 12 combines the previous discussion regarding Communication Service Providers, internetworked to effect the NII, and the connection to an ISP, to show how a client can choose an ISP and be in communication with the selected ISP no matter where they are in the country. At the same time, the ISP is using the NII to access TMC's across the country to service the requests of the client.

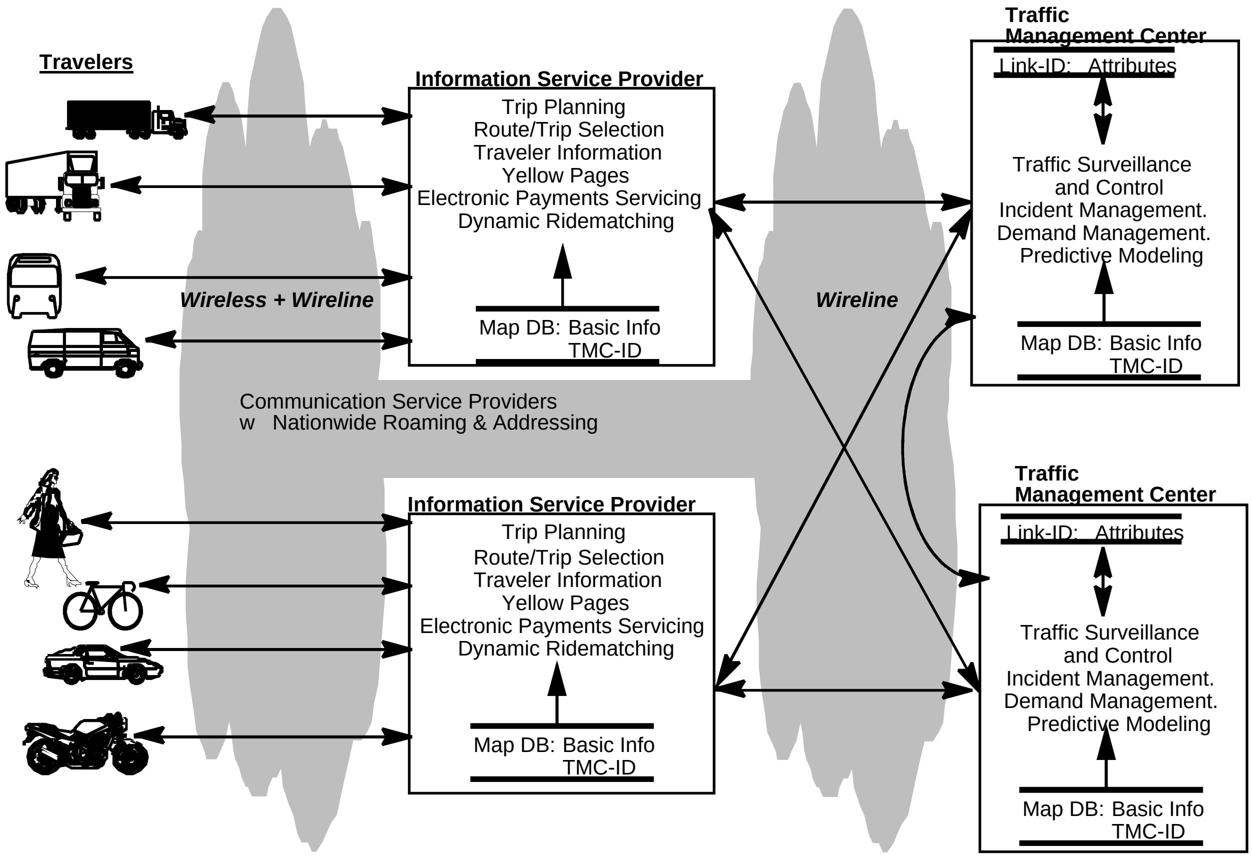

Figure 11 - Open National Compatibility

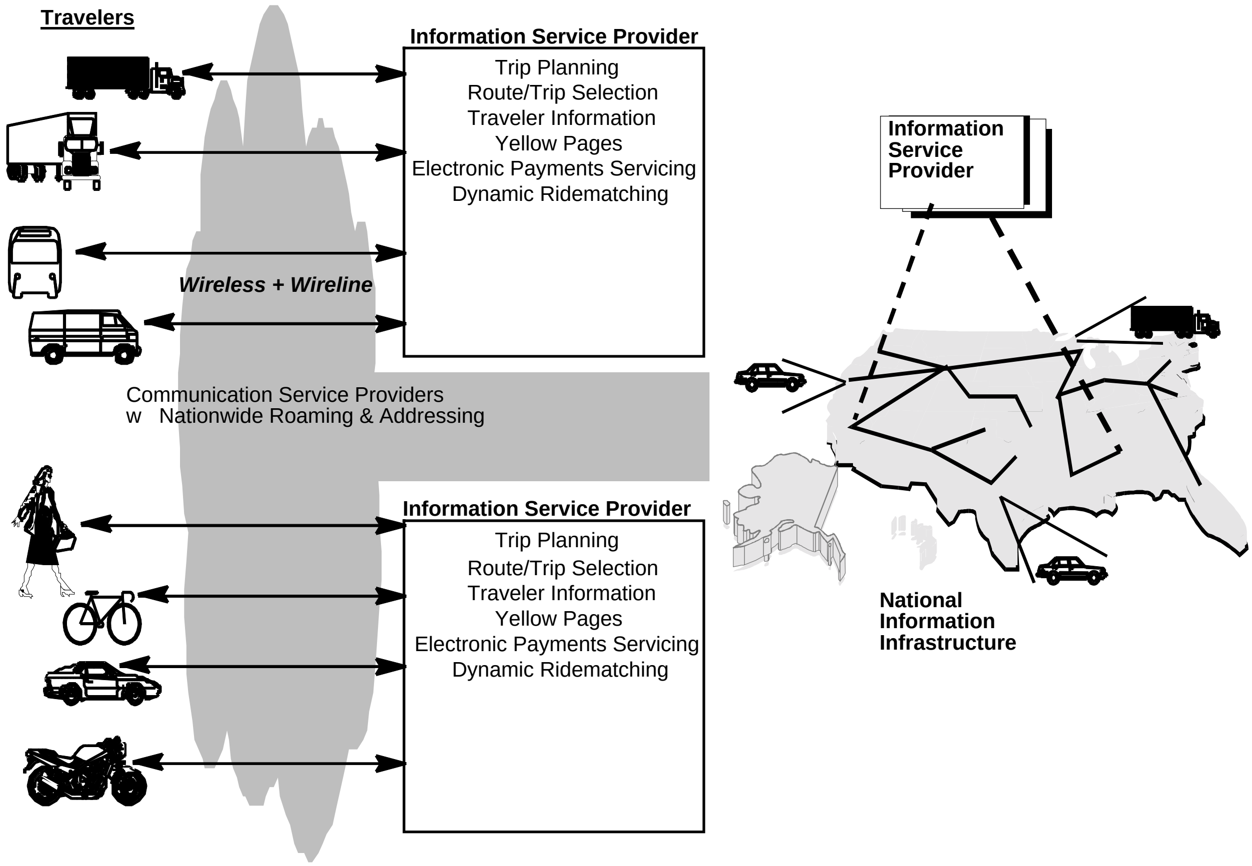

Figure 12 - Traveler to ISP National Interoperability

6 Constraints

This chapter identifies Physical Architecture intersubsystem message performance requirements below the application layer.

6.1 Assessment Categories

The following categories have been used in rating the constraints that exist on the physical data flows.

1. Performance

   a. Emergency Priority

      Essentially "real-time" requirements. Emergency data that is time critical must be received by a certain absolute time, or it is useless. For these flows the communication channel may require priority in emergencies. The data channels required must be operational even when there is an emergency that might place other loads on the interface. A private communication channel or frequency may be required to satisfy the requirement.

   b. Reliability(R)

      This category encompasses both the concepts of reliability and availability. Data must be delivered reliably. Loss cannot be tolerated. The communcations link must also have high availability. Failure of the communication medium may result in severe accident. This communication channel may require redundant paths or extra attention paid to potential failure modes. For wireline cases, this may indicate alternate phone or other connections are required. For wireless cases (e.g., for AHS applications), special attention will be paid to the transmitters, receivers, and potential interference for these connections.

   c. Timing

      The timing constraints are critical. If communication does not occur within set limits, system failures can occur. Timing for most ITS communication services is based on the response to a request for data. Because of this, common communication media designed to handle voice data will likely support these requirements. The beacon interface has special requirements of identifying the vehicle as well as exchanging information before the vehicle gets out of range. This is more of a problem with vehicles traveling at speed. The architecture constrains such time critical access to data such that the data is available at the beacon site. This obviates the need for explicit specification of other timing information to support data transfer over a short range beacon.

      This timing constraint is related to (but not the same as) another attribute often discussed in specifying systems: latency. Latency is used to quantify end-to-end processing and transmission time (round trip delays). Data with a latency requirement must be handled within a certain time interval. This differs from "time criticality" in that it is a relative rather than absolute time requirement (i.e., latency: interface screen must update every 2 seconds; time criticality: route instructions must be received 30 seconds prior to first turning action). Because latency requirements are greatly affected by the implementation of the subsystem elements, it cannot be specified directly when discussing only the interface between two subsystems.

2. Data Sensitivity

   a. Security (S)

      Access to the data must be restricted. Data itself must be secure during transmission. This is typically used for financial information.

   b. Privacy(P)

      Anonymity of the data source or recipient must be protected. This is typically used for personal information.

6.2 Architecture Flow Constraints

Table 1. Architecture Flow Constraints

Source	Destination	Architecture Flow	Interconnects	Communication Service	Special Constraints
Emergency Management	Vehicle	emergency acknowledge	U1t	Conversational data conversational speech	E
Emergency Management	Vehicle	emergency data request	U1t	Conversational data conversational speech	E
Personal Information Access	Emergency Management	emergency notification	U1t	Conversational data, Messaging data	E
Remote Traveler Support	Emergency Management	emergency notification	W,U1t	Conversational speech, Messaging data, location data	E
Vehicle	Emergency Management	emergency notification	U1t	Conversational speech, Messaging data, location data	E

7 Data Dictionary Elements

This section contains the leveled data item (LDI) definitions for all the leveled data item elements listed in this standards requirements package.The LDI's are given in alphabetical order.

call_back_information

This data item allows travelers involved in an incident to reestablish and continue communications with an emergency management system after initial contact has been made and ended. This could be something similar to the driver's mobile phone number.

commercial_hazmat_route_information

This data item contains information about the route about to be used or planned for a commercial vehicle that will carry hazardous materials. This information may cause the Emergency Services to raise an incident for all or part of the vehicle's route.

commercial_hazmat_vehicle_information

This data item contains information about hazardous materials that are on-board the vehicle and details of the vehicle itself.

commercial_route_number

This data item identifies a commercial vehicle route. It can be used to associate other items of data such as taxes and duties, route details, classes, etc.

date

This data item specifies a calendar date that is normally used to indicate currency or effectivity of other data.

driver_information

This data item is used to convey information about the driver. The emergency service providers can dispatch emergency vehicles that will be prepared to give the kind of attention required in each particular situation. Information such as the driver's name, license number, or information about the driver's personal medical history may be included in this data item. Use of this field is voluntary and it should not be coded without the explicit consent of the driver.

emergency_acknowledge_transit_details

This data item is used to confirm that the request for emergency services previously sent by the traveler has been received from a kiosk or other device. This data item may also contain the response to input from a panic button that has been activated by a transit user in part of the transit operational network, i.e. not on-board a transit vehicle, or at a transit stop, but in such things as a modal interchange facility, transit depot, etc. The information will be sent out as part of the response to an emergency or incident being detected within the network.

emergency_data_request

This data item allows an emergency service provider to request additional information from the vehicle following emergency notification. It allows the vehicle and driver to carry on a continuous dialogue with and emergency operator to make sure that the emergency service providers have the information they need to be well prepared to handle the incident. It shall also allow the travelers of a vehicle to request operation of remote controlled security functions of a vehicle such as a door unlocking function.

emergency_information

This data item provides information about current incidents.

emergency_request_driver_acknowledge

This data item acknowledges that the request for emergency services previously sent by the driver has been received.

emergency_request_personal_traveler_acknowledge

This data item confirms that the request for emergency services previously sent by the traveler has been received from a personal device and is therefore sent to the Provide Driver and Traveler Services function for output.

emergency_request_transit_details

This data item is used to send data about an emergency declared by a traveler at a transit stop using a kiosk or other device. This can also be used by the transit user to alert the transit system operator to an emergency situation or incident within the transit operational network, i.e. not on-board a transit vehicle, or at a transit stop, but in such things as a modal interchange facility, transit depot, etc.

emergency_request_traveler_acknowledge

This data item is used to confirm that the request for emergency services previously sent by the traveler has been received from a kiosk or other device.

emergency_request_vehicle_acknowledge

This data item acknowledges that the request for emergency services previously sent automatically by the vehicle through processes in the Provide Vehicle Control and Monitoring function has been received.

emergency_request_vehicle_details

This data item sends data about an emergency automatically declared by a vehicle to the Manage Emergency Services function.

hazmat_load_data

This data item contains the manifest data plus the chemical characteristics of a HAZMAT load being carried by a commercial vehicle. This data is used by the emergency services to plan their responses if the vehicle on which the load is traveling is involved in an incident.

hazmat_request

This data item contains a request for information about hazardous materials that are being or about to be carried by commercial vehicles.

hazmat_vehicle_data

This data item contains details such as make, type, towing points, etc. of a vehicle that is carrying a hazardous load. This is used by the emergency services to plan their responses if the vehicle is involved in an incident.

incident_duration

This data item contains the expected duration of an incident from its start time until the time at which it is expected that it will have no further effect on traffic conditions.

incident_location

This data item contains the location at which an incident will take place (for planned events) or is taking place (for current incidents).

incident_severity

This data item identifies the severity of an incident.

incident_start_time

This data item contains the incident start time.

location_identity

This data item contains the location of any transportation feature, entity, or event in an unambiguous and mutually understandable way.

processed_cargo_data

This data item contains data obtained from the processing by sensors of analog data received on-board the vehicle about the composition and state of its cargo.

request_for_additional_data

This data item allows a vehicle to request additional help and give details to an emergency service provider following involvement in an incident. It allows the vehicle and driver to carry out a continuous dialogue with an emergency operator to make sure that the emergency service providers have the information they need to be well prepared to handle the incident.

request_transit_user_roadside_image

This data item contains a request for the supply of the image of a transit user who has violated the transit fare payment process at a roadside fare collection point.

request_transit_user_vehicle_image

This data item contains a request for the supply of the image of a transit user who has violated the transit fare payment process at an on-board vehicle fare collection point.

route_cost

This data item contains the cost of using a particular route. This is made up of some or all of such things as tolls, fares, port charges, plus the cost of commercial vehicle credential filing and tax payments.

route_list

This data item contains a list of the number of route segments in each route that is being provided to a traveler.

route_segment_description

This data item contains a description of the physical details for the entire route segment. This data is used to provide information from which guidance can be produced in a form which is understandable by the driver, e.g. lane selection, right/left turns, etc.

route_segment_end_point

This data item contains the location of the end of a route segment.

route_segment_estimated_arrival_time

This data item contains the estimated time at which the route segment end point will be reached.

route_segment_estimated_condition

This data item contains the traffic conditions expected on the route segment at the time at which it will be used.

route_segment_estimated_travel_time

This data item contains the estimated time it will take a vehicle to travel the route segment taking account of the expected conditions defined in other data.

route_segment_identity

This data item identifies a route segment by name, location, or other standard location reference.

route_segment_mode

This data item contains the mode that has been selected for use within the route segment. The choice of mode is made as part of the trip planning process. Only one mode can be used in any single route segment.

route_segment_predicted_weather

This data item contains the weather conditions expected on the road segment at the time at which it will be used.

route_segment_start_point

This data item contains the location of the start of a route segment.

route_start_time_date

This data item contains the date and time at which a route will start taken from the time specified in the request for the route.

route_statistics

This data item contains the overall predicted statistics associated with a route which may assist the traveler in making a final route selection. The statistics will include such things as itinerary, estimated net travel time, time of arrival, total distance, anticipated delays/congestion, etc.

time

This data item contains the current time of day and will be associated with other data items and (possibly) a date.

transit_coordination_information

This data item contains incident response coordination information for use by processes in that function.

transit_driver_emergency_request

This data item contains a request for action because a transit driver has identified an emergency situation on-board or close to a transit vehicle.

transit_emergency_data

This data item contains details of an emergency on-board a transit vehicle.

transit_emergency_details

This data item contains details of emergency requests that have been input on-board a transit vehicle.

transit_emergency_information

This data item contains details of emergency requests that have been input on-board a transit vehicle.

transit_fleet_operation_request

This data item contains a request for the transit system operator to take specified actions in response to an incident.

transit_incident_details

This data item contains details of an incident in the transit operations network.

transit_operator_emergency_request

This data item contains information about an incident that has been detected on board a transit vehicle or at a transit facility following input from a transit user or transit vehicle driver.

transit_operator_request_acknowledge

This data item contains an acknowledgment that the previous notification of an emergency to the transit system operator has been received and is being considered for action.

transit_response_to_incident

This data item contains details of what transit action is required in response to an incident. It is used by processes within that function.

transit_user_emergency_request

This data item contains a request for action because a transit user has identified an emergency situation on-board or close to a transit vehicle.

transit_user_roadside_image

This data item contains a compressed image of the transit user who has violated the transit fare collection process at the roadside, i.e. at a transit stop. The data will be used in subsequent transit fare violation processing.

transit_vehicle_identity

This data item contains the identity of an individual transit vehicle. This data is used to identify the source and/or ownership of other data.

transit_vehicle_location

This data item provides the exact location of the transit vehicle. It contains the transit vehicle location plus its identity.

transit_vehicle_location_data

This data item provides the exact location of the transit vehicle. It is based on the standard vehicle location data supplemented with additional data that is only relevant to transit vehicles.

traveler_identity

This data item contains the identity of the traveler who is making a request for information or guidance, so that the results of the request can be sent back to the originating traveler.

traveler_location_for_emergencies

This data item contains the traveler's location as computed from sensor data. This is a high precision data item that enables the location of the traveler to be pin-pointed to a high degree of accuracy and is used to provide the destination for the emergency services to the emergency call-out message.

vehicle_crash_sensor_data

This data item contains data obtained from the processing by sensors of analog data received on-board the vehicle. This data provides information about the effects of a crash in which the vehicle has been involved.

vehicle_identity

This data item contains the identity of a vehicle.

vehicle_security_status

This data item contains the status of the vehicle's security systems, which include the lock system and/or alarm system. This data item could be a coded representation of the status(e.g.. LE- locks engaged, LD-locks disengaged).

vehicle_security_system_commands

This data item allows mayday service providers the ability to send commands to a vehicle. These commands include changing the security settings such as operating the door locks or disabling an alarm system remotely.

vehicle_system_status

This data item contains the operational status of various systems within the vehicle, such as braking, engine, and safety devices. This could be a coded representation of the system status. It may but not be limited to describing information such as engine not at operating temperature, driver in control of the vehicle, vehicle under automatic control, vehicle in acceleration mode, speed increasing, vehicle in deceleration mode, speed decreasing, vehicle in braking mode, brakes on, potential vehicle fault, vehicle safety fault, or a set of parameters with values associated.